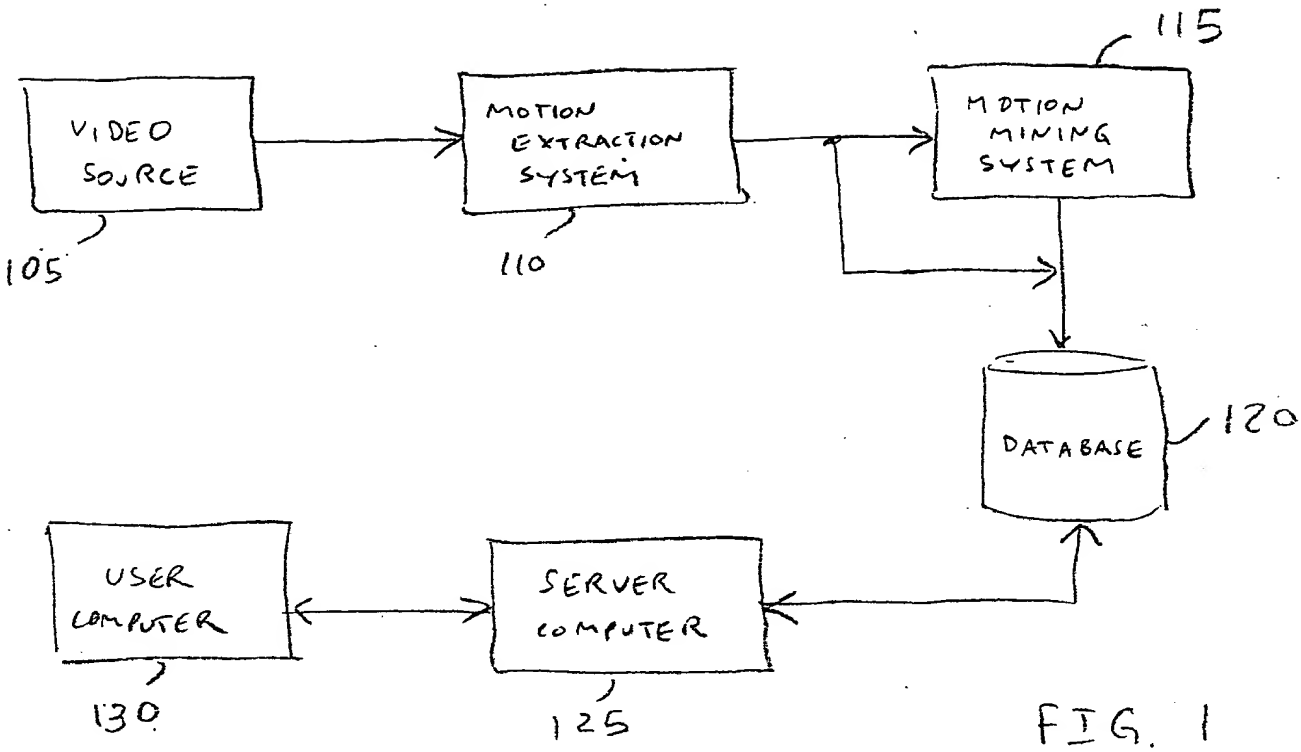

VIDEO SOURCE
105
MOTION EXTRACTION SYSTEM
110
115
MOTION MINING SYSTEM
DATABASE
120
USER COMPUTER
130
SERVER COMPUTER
125

FIG. 1

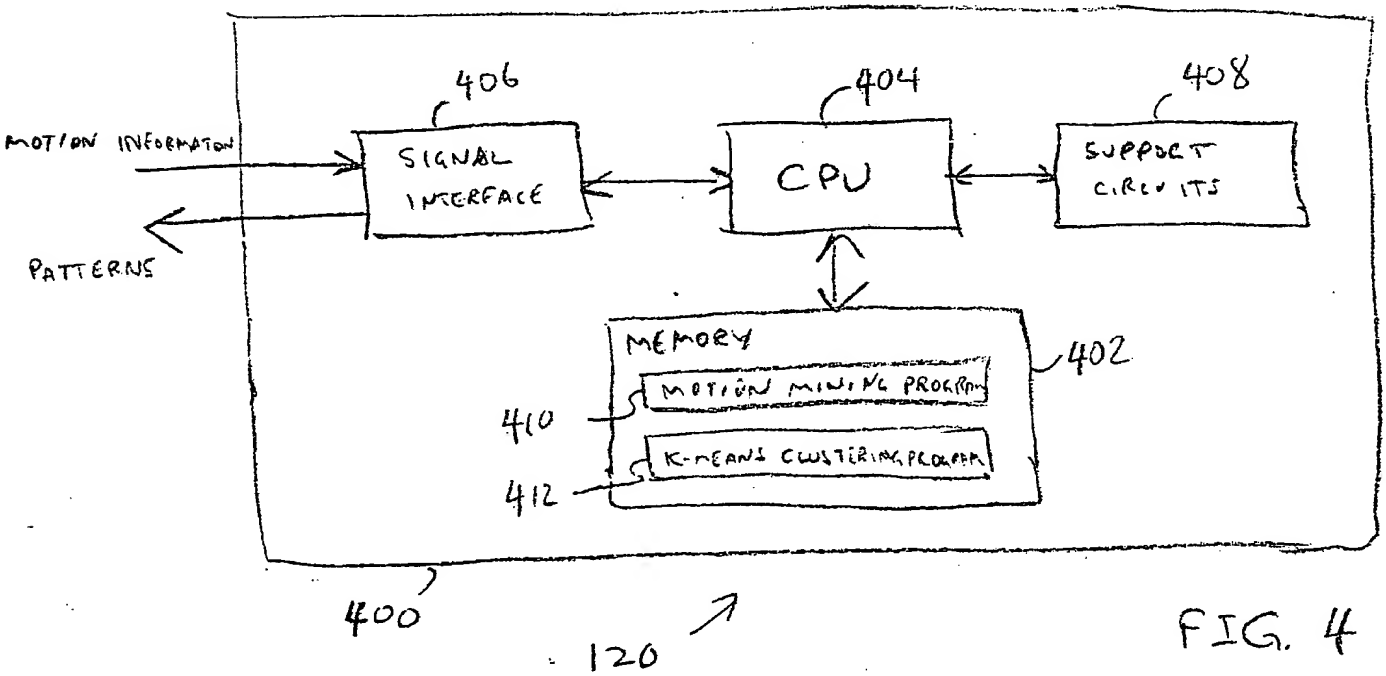

406
404
408
MOTION INFORMATION
SIGNAL INTERFACE
CPU
SUPPORT CIRCUITS
PATTERNS
MEMORY
402
MOTION MINING PROGRAM
410
K-MEANS CLUSTERING PROGRAM
412
400
120

FIG. 4

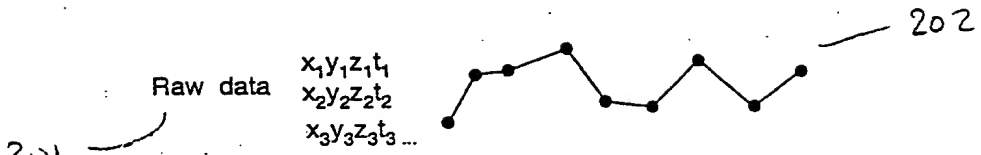
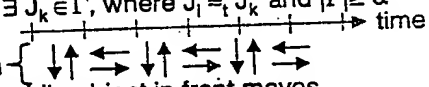


FIG. 2A

MOTION (TRAJECTORY) INFORMATION	Symbol	OPERATION ON RAW DATA	Explanations
Time span	T	range	
Region	R	area, $\cap$	
Begin point	B	$\subset$	contained in
End point	E	$\subset$	contained in
Speed range	S	$\cap, \subset, \supset$	
Direction	V	$\approx_\theta$	
Accel range	A	$\cap, \subset, \supset$	
Shape	H	$\approx$	
Path	P	$\Sigma, \approx_t, \approx_o$	union, time shifted, overlap

206

FIG. 2B

Motion patterns examples	Query based on operators (α, β are user input/parameters)
• Object stopping	$\{J: J.A \cap [-\infty, 0)$ and $0 \in J.S\}$
• Object moving fast	$\{J: J.S \in [\alpha, \infty)\}$
• Active region	$R = \cap J_i.R$, where $\lvert\{ J_i \}\rvert > \alpha$ and $R.area < \beta$
• Source region	$R = \cap J_i.B$, where $\lvert\{ J_i \}\rvert > \alpha$ and $R.area < \beta$
• Beaten path	$P = \Sigma J_i.P$, where $\forall J_i$, $\lvert\{ J_k: J_k \approx_o J_i \}\rvert > \alpha$
• Road	beaten path with $\alpha=1$
• Convoy	$\Gamma = \{J_i\}$: $\forall J_i \in \Gamma \; \exists J_k \in \Gamma$, where $J_i \approx_t J_k$ and $\lvert\Gamma\rvert \geq \alpha$
• Ran a traffic light	deviation from traffic direction  time
• Illegal parking	object stopped while object in front moves

310

300

FIG. 3

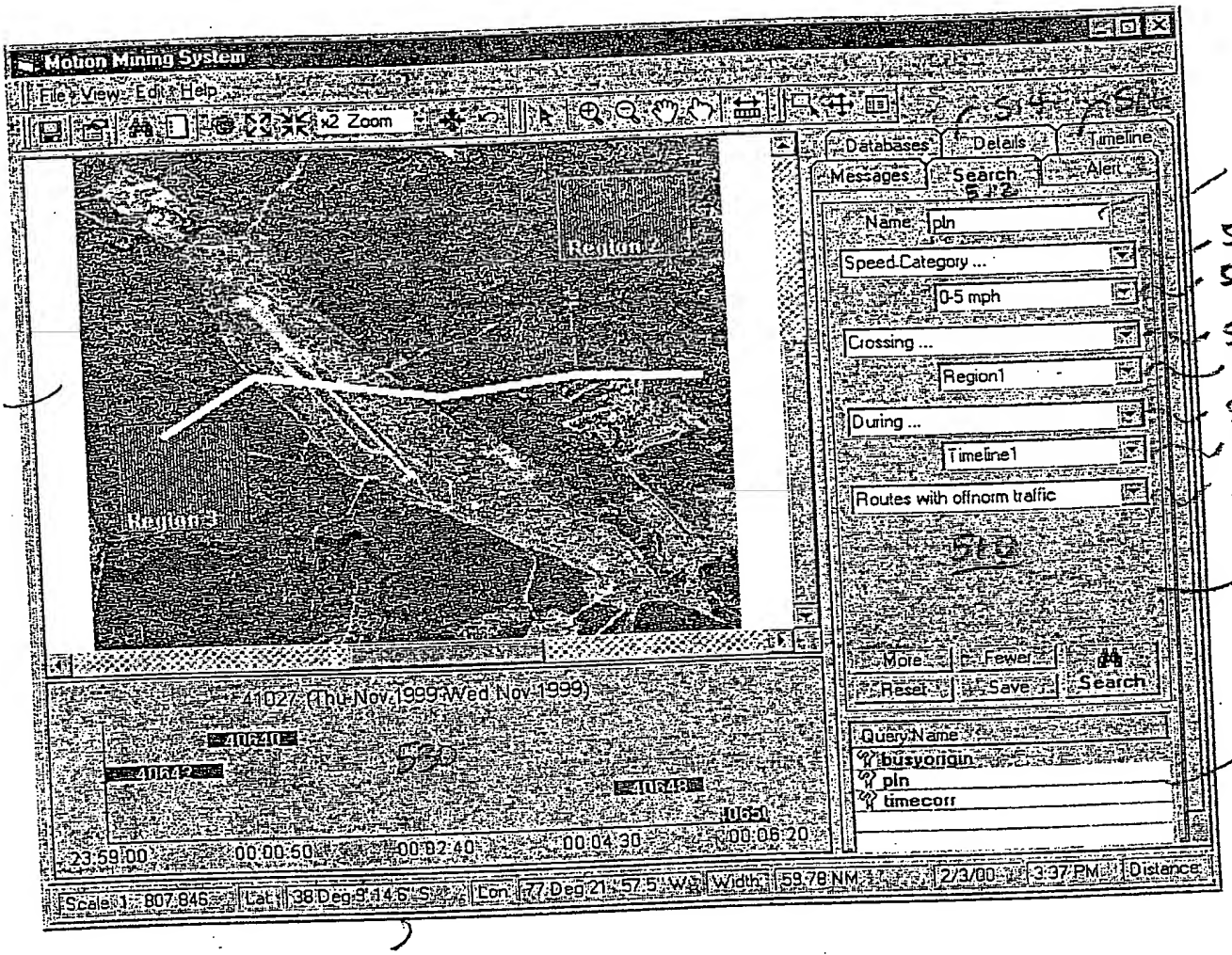

Motion Mining System
File View Edit Help
x2 Zoom
Databases
Details
Timeline
Messages
Search
Alert
Name pln
Speed Category ...
0-5 mph
Crossing ...
Region1
During ...
Timeline1
Routes with offnorm traffic
More
Fewer
Reset
Save
Search
Query Name
busyorigin
pln
timecorr
Region2
Region3
41027 (Thu Nov 1999-Wed Nov 1999)
23:59:00
00:00:50
00:02:40
00:04:30
00:06:20
Scale 1 : 807,846
Lat 38 Deg 9' 14.6" S
Lon 77 Deg 21' 57.5" W
Width 59.78 NM
2/3/00
3:37 PM
Distance
520
500
562
554
554C
556
556C
558
558C
560
550
552

FIG 5

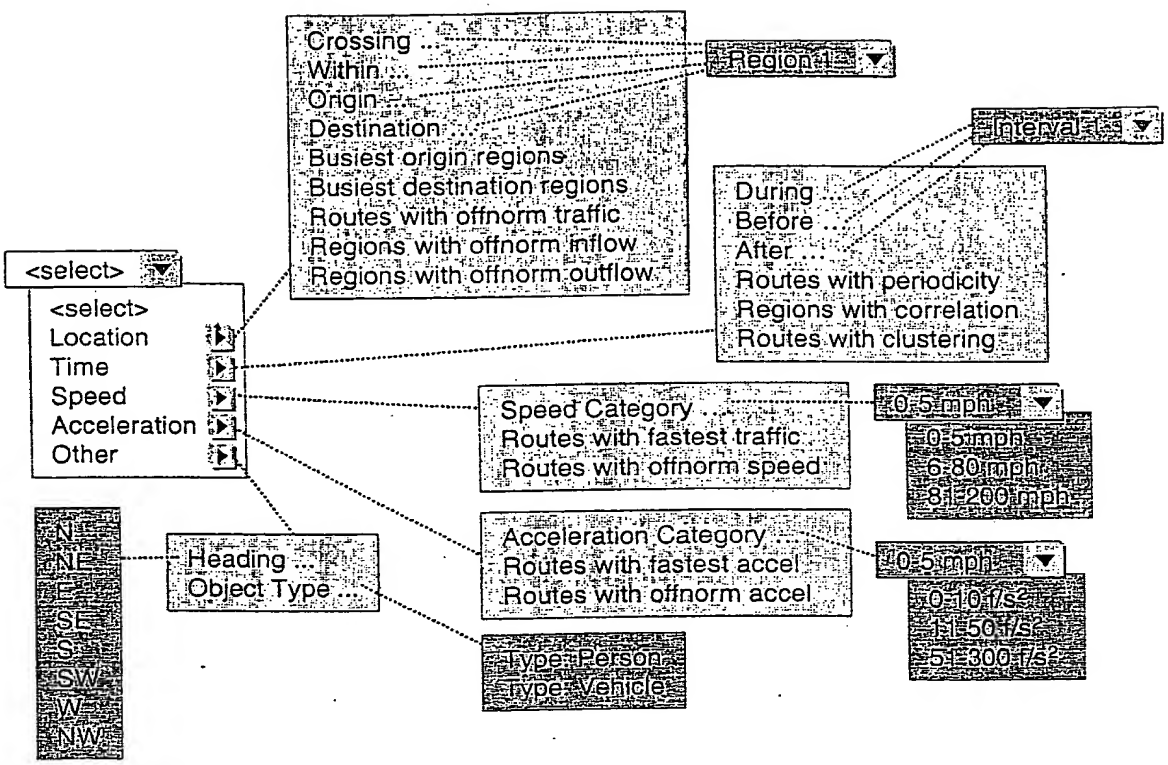
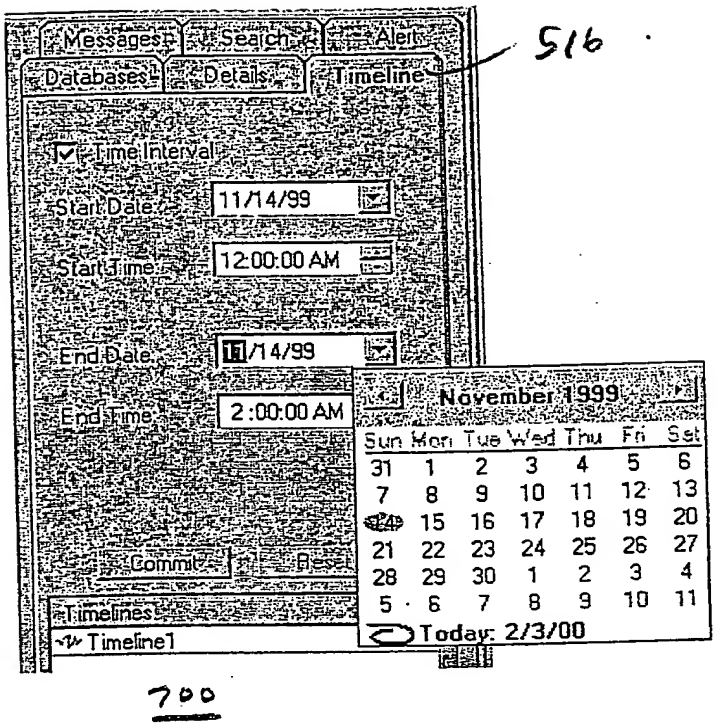
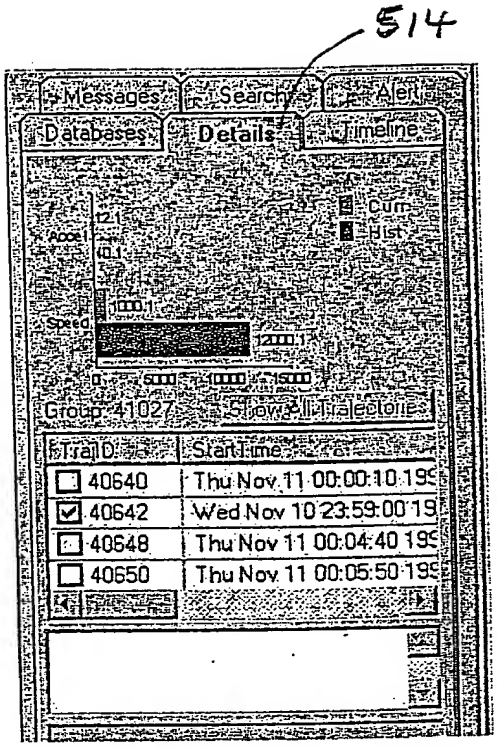

<select>
<select>
Location
Time
Speed
Acceleration
Other
Crossing ...
Within ...
Origin ...
Destination ...
Busiest origin regions
Busiest destination regions
Routes with offnorm traffic
Regions with offnorm inflow
Regions with offnorm outflow
Region 1
During ...
Before ...
After ...
Routes with periodicity
Regions with correlation
Routes with clustering
Interval 1
Speed Category ...
Routes with fastest traffic
Routes with offnorm speed
0-5 mph
0-5 mph
6-80 mph
81-200 mph
Acceleration Category ...
Routes with fastest accel
Routes with offnorm accel
0-5 mph
0-10 ft/s²
11-50 ft/s²
51-300 ft/s²
Type: Person
Type: Vehicle
N
NE
E
SE
S
SW
W
NW
Heading ...
Object Type ...

FIG. 6



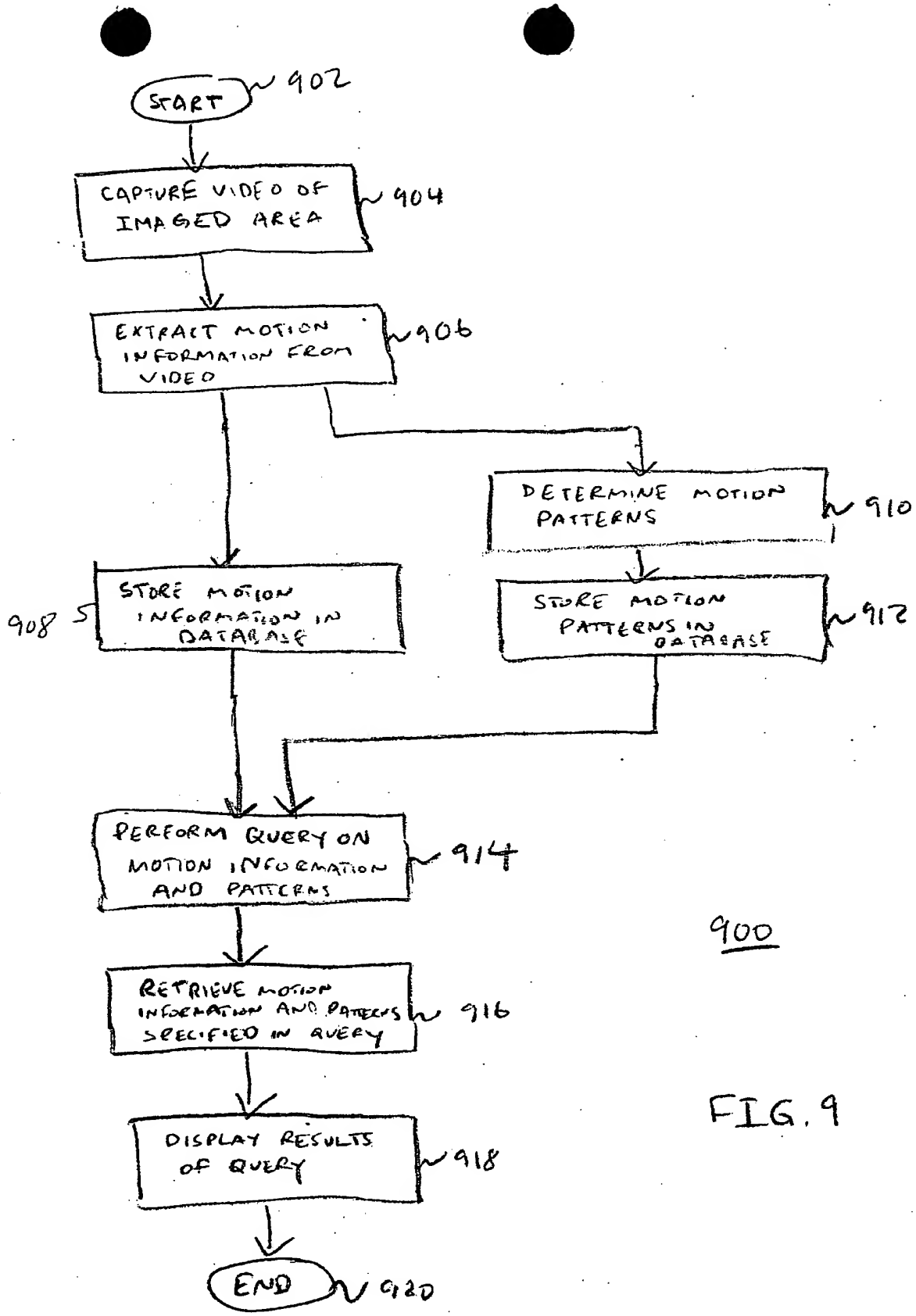
700

FIG. 7



800

FIG 8


START
902
CAPTURE VIDEO OF IMAGED AREA
904
EXTRACT MOTION INFORMATION FROM VIDEO
906
DETERMINE MOTION PATTERNS
910
STORE MOTION INFORMATION IN DATABASE
908
STORE MOTION PATTERNS IN DATABASE
912
PERFORM QUERY ON MOTION INFORMATION AND PATTERNS
914
RETRIEVE MOTION INFORMATION AND PATTERNS SPECIFIED IN QUERY
916
DISPLAY RESULTS OF QUERY
918
END
920

900

FIG. 9

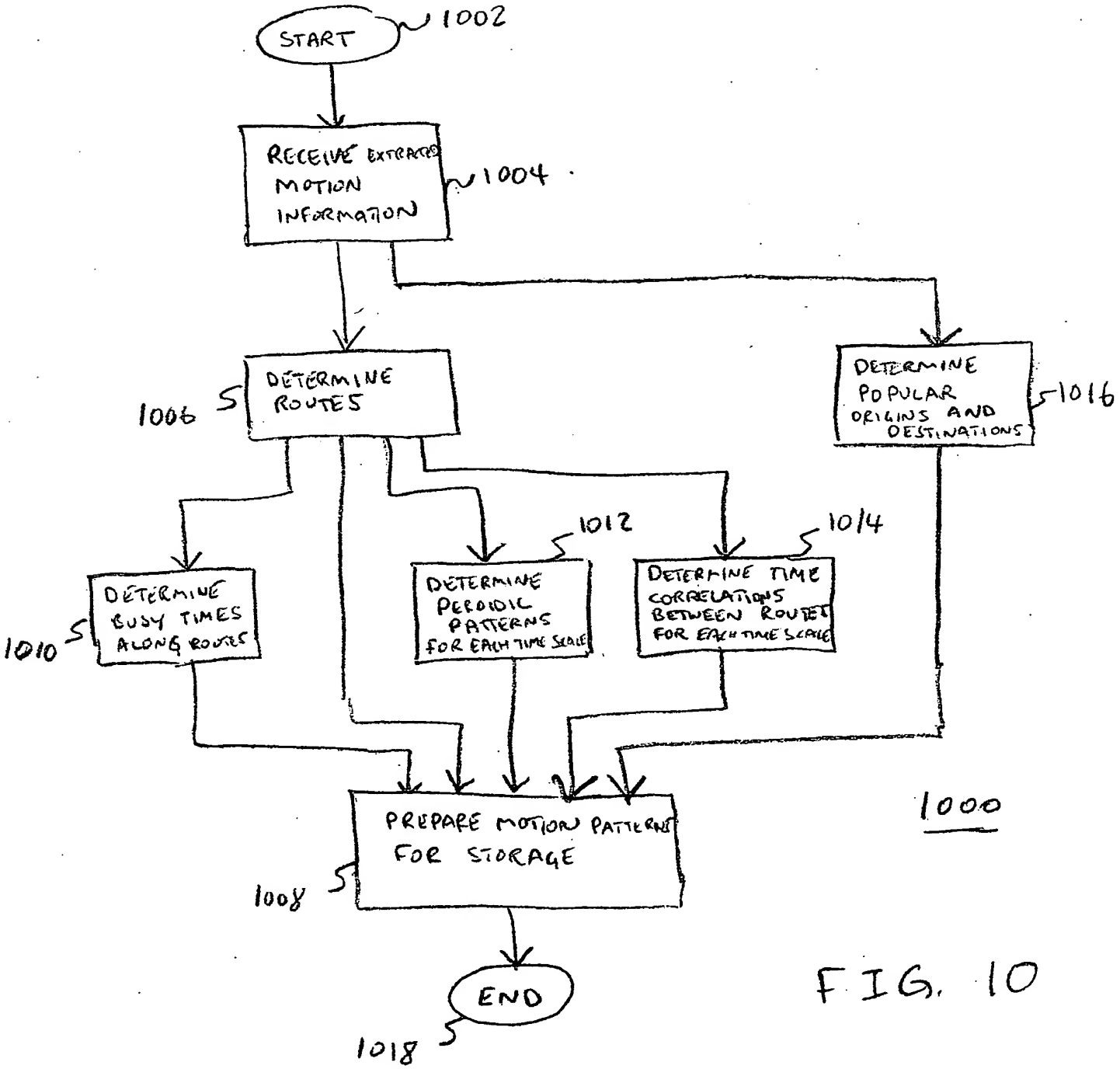

START
1002
RECEIVE EXTRACTED MOTION INFORMATION
1004
DETERMINE ROUTES
1006
DETERMINE POPULAR ORIGINS AND DESTINATIONS
1016
DETERMINE BUSY TIMES ALONG ROUTES
1010
DETERMINE PERIODIC PATTERNS FOR EACH TIME SCALE
1012
DETERMINE TIME CORRELATIONS BETWEEN ROUTES FOR EACH TIME SCALE
1014
PREPARE MOTION PATTERNS FOR STORAGE
1008
END
1018
1000

FIG. 10